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ABSTRACT

Prospective teachers have well-developed beliefs about learning and teaching that can form obstacles to instruction. Two studies explored a set of beliefs that preservice teachers expressed about learning, teaching, and the role a course in educational psychology played in their professional training. In the first study, a set of preservice teachers' beliefs about learning and teaching were identified as well as specific steps for taking those beliefs into account in teacher education. The results of the study indicated that many more preservice teachers felt their views of learning and teaching changed when preconceptions were targeted in instruction than when they were not. In Study 2, preservice teachers were asked to define learning and teaching before and after taking a course in educational psychology, and to describe how their beliefs had changed as a result of taking the course. The studies suggest that targeting preservice teachers' prior beliefs in instruction has a significant impact on their beliefs about learning and teaching. A glossary and two frequency tables are appended. (Contains 23 references.) (Author/ND)

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RUNNING HEAD: Preservice Teachers' Prior Beliefs

Preservice Teachers' Prior Beliefs: Transforming Obstacles into Opportunities

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Abstract

Prospective teachers have well-developed beliefs about learning and teaching that can form obstacles to instruction. In the first study, we identify a set of beliefs preservice teachers expressed, and describe how we took these beliefs into account when teaching preservice teachers. In Study 2, we asked preservice teachers to define learning and teaching before and after taking a course in educational psychology, and to describe how their beliefs had changed as a result of taking the course. The studies suggest that targeting preservice teachers' prior beliefs in instruction has a significant impact on their beliefs about learning and teaching.

Preservice Teachers' Prior Beliefs: Transforming Obstacles into Opportunities

Prospective teachers have a well-developed set of personal beliefs about learning and teaching prior to entering their teacher preparation program (Calderhead, 1991a, 1991b; Holt-Reynolds, 1992; Lonka, Joram, & Bryson, 1996; Wubbels, 1992; Zeichner & Gore, 1990). As in domains such as mathematics and science, prior beliefs that remain unaddressed can form obstacles to instruction because they make it likely that all new information and perspectives will be assimilated into existing knowledge structures (Kagan, 1992; Slotta, Chi, & Joram, 1995). For example, Kagan (1992) points out that preservice teachers' prior knowledge acts as *filters* through which others' teaching performances are interpreted; even observations conducted during field experiences, therefore, do not effect significant changes in preservice teachers' prior beliefs.

The filters created by prior beliefs can make effective communication between preservice teachers and teacher educators problematic. For example, Holt-Reynolds (1992) found that, whereas her preservice teachers believed a teacher's role is to transmit knowledge to students, their methods course instructor saw it as helping students become skillful producers of knowledge. Because of the unrecognized differences in the perspectives of the preservice teachers and their methods instructor, meaningful dialogues leading to changes in their perspectives were precluded. This suggests that if teacher educators are interested in altering the

ways preservice teachers think about teaching and learning, prior beliefs must be actively addressed in teacher education programs. Recognizing and working with prior beliefs may increase the likelihood that core courses in teacher education programs will help preservice teachers construct "new psychological perspectives useful for teaching" (Anderson, Blumenfeld, Pintrich, Clark, Marx, & Peterson, 1995).

Many have described the nature of preservice teachers' prior beliefs (e.g., Bird, Anderson, Sullivan, & Swidler,1993; Calderhead, 1991b; Wubbels, 1992), pointed out that beliefs are deeply entrenched and difficult to change (e.g., Tabachnick & Zeichner, 1984), and have offered general suggestions for dealing with them (e.g., Wubbels, 1992), yet few specific suggestions have been given of ways teacher educators can successfully deal with particular beliefs. In this paper, we describe a set of beliefs that preservice teachers expressed about learning, teaching, and the role a course in educational psychology played in their professional training. We describe how, in Study 1, these particular beliefs were taken into account when teaching a subsequent educational psychology course to a new set of preservice teachers. We present empirical support documenting the impact these steps had by reporting preservice teachers' responses to questions about changes in their views of learning and teaching. In Study 2, we investigate whether subjectively perceived changes by preservice teachers were accompanied by actual changes in their views of learning and teaching. Views of learning and teaching were targeted as indices of

belief change because researchers have identified these views as *core concepts* in educational psychology: concepts that are common to those trained within a cognitive/constructivist framework, and which mediate the manner in which students think about the discipline (Lonka, Joram, & Bryson, 1996).

Study 1 - The Impact of Instruction on Perceived Changes in Beliefs

During the 1995 fall semester, the first author (E.J.) taught two sections of an introductory course in educational psychology, taken by sophomores through seniors who primarily majored in elementary education and minored in a variety of different areas. Students were in the second phase of their undergraduate teacher education program, and had taken a course in developmental psychology and completed a field experience in Phase 1.

The approach taken throughout the educational psychology course was very constructivist, with learning portrayed as an active process of inquiry and the teacher as one who sets up situations designed to facilitate student learning and who scaffolds and guides preservice teachers' thinking. Near the end of the course, E.J. interviewed each of the 40 preservice teachers and asked them to talk about their experiences in the course. The same beliefs were echoed over and over again and, consistent with findings of other instructors (Bird et al., 1993), it seemed that not even the surface of students' well-developed belief systems about learning and teaching had been scratched. We then redesigned the course in such a way that dealing with preservice teachers' prior personal beliefs became a top priority.

In domains such as science, the "teaching for conceptual change approach" (Posner, Strike, Hewson, & Gerzog, 1982) has been used successfully to deal with students' prior beliefs. After "dredging up" the beliefs, experiments and demonstrations are performed to vividly illustrate for students the limitations of their beliefs (e.g., Hunt & Minstrell, 1994). In educational psychology, however, it is difficult to perform such demonstrations and we had to find other ways of persuading students to consider alternate points of view. Below, the preservice teachers' beliefs we identified are described as well as the steps taken to address them in Study 1.

Belief 1 - "University Courses Have Little to Offer Prospective Teachers – I Should be Out in the Field"

Book, Byers, and Freeman (1983) found that preservice teachers believed "experience is the best teacher," leading them to list field experiences and on-the-job training as the most valuable sources of professional knowledge. Ranked below these experiences were courses in their major field of study and methods courses; educational psychology courses were ranked still lower in importance. The first obstacle we thus encountered is that many of the preservice teachers in our program believe there is little to be learned about the professional skills of being a teacher from taking an educational psychology course. Instead, our student teachers believe they will learn all they need to know about becoming a teacher from the field experience they complete concurrently. The overweighting of field experience makes

sense for certain kinds of skills, if one wants to learn to roller skate, for example, one would no doubt learn more from practicing roller skating than from studying theories of expertise in roller skating. Teaching is a much more complex skill than roller skating, however, and we believe there are many reasons that a course in educational psychology can valuably supplement the apprenticeship our preservice teachers undergo in their field experience.

Wubbels (1992) suggests that metaphors and analogies are among the tools most likely to deal effectively with preservice teachers' preconceptions, which he refers to as "world images." To communicate the relevance of the course for their professional training, E.J. began the course with the analogy of driving instruction: there is an in-class component in driver education as well as a "field experience" component. She asked her students to think about why high-quality driver education programs include both components -- why not just hop in the car with mom or dad, and learn everything through an apprenticeship approach?

Through discussion, E.J. identified three key advantages of completing coursework in a university setting: First, students can learn about situations they will not necessarily encounter in their practice driving, for example, what to do when a tire blows out or when their brakes fail. Similarly, in their field experience (which takes place in the Midwest), they may deal with few issues relevant to cultural diversity; studying diversity in the classroom may help them if they get a job on the West Coast after graduating.

Second, students can become acquainted with research findings. Discovering that research shows the most dangerous time to drive is in the summer may make them drive more cautiously on a beautiful summer's day. In the context of teacher training, research can acquaint preservice teachers with the practice of many teachers, and take them beyond the strengths of their particular field experience supervisors. This echoes the views of Stoddart and Floden (1996), who note that, in contrast to college-based teacher education, programs emphasizing field work and instruction by teachers narrow the range of settings for which teachers are prepared. College-based teacher education, on the other hand, helps students to break out of the restrictions of their individual school experience, expanding their views of pedagogy and familiarity with a range of instructional approaches (Stoddart & Floden, 1996).

Finally, students were told that they would have an opportunity to learn principles, or frameworks, that underlie practice. For example, the principle of driving defensively underlies many of the different rules that one learns when driving, and this principle allows multiple rules to be put together into one coherent picture. When students encounter an unfamiliar problem, solutions can be generated based on their understanding of principles. Similarly, students were told that they would be presented with different theories of educational psychology and that they would be able to see how different rules and practices cohere, and how solutions to novel problems could be generated from principles.

Belief 2 - "My teacher did that to me and I turned out okay" (or The Seduction of False Causal Relationships)

Students have all been taught for many years by teachers and by their parents, engaging in what Lortie (1969) refers to as an "apprenticeship of observation." Most feel they learned effectively at the hands of these instructors and identify a variety of features to which they attribute this success (Anderson et al. 1995), such as the traditional "teaching as telling" model. In order to make preservice teachers aware that: a) they have intuitive beliefs about teaching/learning, and b) there may be alternative, preferable beliefs, E.J. began with an exercise[1] in which preservice teachers were asked to think about the best teacher they ever had and to list all the characteristics they thought were related to that person's skill at being an effective teacher. They were then asked to circle the single most important characteristic, and to turn in their paper[2].

In the next class, E.J. produced a list of all the characteristics, organized into two unlabeled categories: those dealing with affect and motivation (e.g., "conveyed enthusiasm," "made learning fun," "easy to listen and talk to," "got us motivated"), and those dealing with knowledge and learning ("actively involved students in the learning process," "knowledgeable," "made you think," "challenging"). The majority of the characteristics listed fell into the first category, and students were asked to figure out the basis on which the characteristics were categorized. After students

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[1] Adapted from A. M. Iverson.

identified the characteristics of each category, E.J. pointed out that only one side of teaching/learning was well-represented in their responses. The exercise was used to make students aware that they already have many beliefs about what makes the learning/teaching process effective, and that there may be good reason to critically examine these beliefs. This exercise brought prior beliefs to the fore so they could be examined, and it also began a process of reflection on personal beliefs about learning and teaching that continued throughout the course; whenever a new topic was introduced (e.g., creativity, motivation), students completed an exercise designed to dredge up and make public their prior beliefs. Because teaching is an ill-defined domain it is difficult for the teacher-educator to defend any particular position we teach as the correct one (Holt-Reynolds, 1992), and so E.J. always acknowledged the value of students' definitions, while at the same time pointing out how there might be room for change.

Belief 3 - "Learning and Teaching are Nonproblematic"

Preservice teachers often overestimate the performance of their prospective pupils (Holt-Reynolds, 1992). Holt-Reynolds (1992) found that the preservice teachers she studied had an image of their prospective students' grasp of literature that was completely at odds with research findings. She suggests that because each student teacher views themself as the prototype for their own students and generalizes from this sample of one, they may overestimate the abilities of the

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[2] *Note*: Alternatively, each student can call out the characteristic they identified while the instructor writes them on an overhead, simultaneously classifying them.

students they will be teaching. Further, because they do not view learning as problematic, it follows that they will also view teaching as non-problematic except in areas where existing problems are visible, such as classroom management. Calderhead (1991b) has similarly noted that some student teachers believe that teaching is unproblematic, everyone can teach, and one does not need to learn anything in particular about teaching in order to become a teacher.

Whereas simply informing prospective teachers that national assessments indicate students have difficulty learning school subject matter seems to have little impact on their thinking, showing them samples of K-12 students' work makes a big impression. For example, E.J. found her students to be very surprised when they saw how an average fifth-grade Midwestern student (whose national achievement test scores would usually be well above average) writes an expository text. Seeing the "data" started them questioning whether students' learning is adequate, and they subsequently became more receptive to considering that traditional teaching methods may be in need of revision.

Belief 4 - "The "Learning Part" is Easy – It's Managing the Class that I'm Worried About"

Many of E.J.'s students reported believing that classroom management is the most difficult aspect of teaching and the topic of greatest need of study. Because classroom management is the number one concern of these preservice teachers, E.J. began the course with this topic, attempting to connect with, and build upon their

interest. She then situated lesson planning, the next topic, within management by explaining that to have a well-managed class, a teacher needs to have a clear lesson plan. This link is made by making reference to Kounin's (1970) concept of *movement management* -- that the lesson must move smoothly from segment to segment. The point is made that lesson plans are helpful, especially for beginning teachers, in order to achieve effective movement management. This, in turn, leads to a better managed class.

From the discussion of the relationship between classroom management and lesson planning, E.J. moved into the topics of teacher-directed and student-centered lessons. Students had a chance to design and present a group lesson, and after they experienced the difficulty of designing an effective lesson, cognitive theory was introduced as a tool that may be used to help accomplish this. Motivation was then discussed (a topic that is high interest for the students), particularly the effects of feedback on intrinsic motivation. At this point in the course, cognitive theory was tied in with motivation, aiming for a more differentiated view of motivation than "learning should be fun." Behavioral theories were covered briefly, focusing on the use of feedback in students' learning, and evaluating the use of praise, rewards and punishments in light of what was previously covered on the effects of feedback on intrinsic motivation. Nesting each topic within the other helped motivate them all from the center core of classroom management, which preservice teachers were

greatly concerned with. In this way their natural interest in classroom management is harnessed and built upon to motivate other topics in the course.

Preservice Teachers' Responses to Instruction

What evidence do we have that the suggestions given above are effective? At the end of the both the fall course (where prior beliefs were not taken into account in instruction) and the spring course (where prior beliefs were taken into account), we gave preservice teachers an anonymous, open-ended questionnaire: "Describe how your views of learning have changed as a result of this course. If you think they have not changed, please explain why, focusing on your role as well as the role of the instructor." The same question was asked regarding "teaching." Classifications of students' responses, and examples follow:

No change or prior belief reported - Examples: "Not changed - I'm set in my beliefs"; "I believe learning has to be fun";

Added new information to pre-existing views - Examples: "This course has helped me develop knowledge about a wide range of learning strategies"; "I now know different methods of studying"

Changed views of learning and teaching -

Examples of comments about learning: "Learning is more than memorizing and preparing yourself for a test. Learning is being able to understand and identify concepts"; "I have discovered ways to make learning more meaningful for a child";

"I used to always think of the teacher teaching the learner and the learner not taking such an active role, but my views have definitely changed."

Examples of comments about teaching: "I have become aware that it is more important how to get an answer rather than getting the correct answer"; "I have discovered that a teacher is not just a person who stands in front of a classroom blurting out information that students must remember. Teachers are there to help students learn how to find and think about information on their own. They are present to develop thinking processes, not just to give answers."

Questionnaire results indicate that 21% of students in the fall sections (n = 40) felt they had learned nothing about learning and 24% felt they had learned nothing about teaching. Only 6.5% of preservice teachers in the spring sections (n=49) felt this way about their views of learning, and 14% about their views of teaching. Looking only at the category in which students' responses suggested they had changed their views of learning/teaching, 17% of fall semester preservice teachers reported a significant change in their views of learning and 26% in their views of teaching. Of the spring semester students, 35% felt their views of learning had significantly changed and 57% felt their views of teaching had changed. These results indicate that twice as many preservice teachers in the spring sections of the course, compared to the fall sections, reported that significant changes had occurred in their views of learning and teaching.

In Study 1, preservice teachers' prior beliefs about learning and teaching were identified as well as specific steps for taking these beliefs into account in instruction. Suggestions for dealing with the beliefs included: 1) devoting time at the beginning of the course to establishing its relevance for preservice teachers' professional training; 2) continually dredging up preservice teachers' intuitive beliefs throughout the course and presenting them as objects of reflection; 3) convincing preservice teachers there are problems in learning/teaching by showing them typical work students produce at different grades, and 4) using a "nested approach" to structure topics covered in the course, building from the central core of the topic of classroom management.

The results of this study indicate that many more preservice teachers felt their views of learning and teaching had changed when preconceptions were targeted in instruction than when they were not. In order to determine whether preservice teachers' subjective sense that a change in perspectives had occurred was accompanied by actual changes in these perspectives, a second study was conducted.

Study 2 - Changes in Beliefs about Learning and Teaching

Study 1 found that targeting prior beliefs in instruction results in preservice teachers feeling that their beliefs had changed as a direct result of this instruction. It is possible, however, that preservice teachers might feel that changes in their beliefs had occurred while still clinging to initial preconceptions. Study 2 sought to extend the results of Study 1 by examining whether subjectively perceived changes in beliefs were accompanied by actual changes in beliefs about learning and teaching.

In Study 2, preservice teachers in two sections of an introductory educational psychology course participated. Responses from two students who were repeating the course were discarded, yielding 53 participants in total. The design of the course was identical to that described above, and included instruction targeting preservice teachers' preconceptions. Participants were similar in level and program to those included in Study 1.

On the first day of class, students filled out a questionnaire that asked them to define learning and teaching (*Pretest*). During the last week of a 16-week semester, students filled out a second questionnaire, which again asked them to define learning and teaching (*Posttest*). On the posttest, students were also asked whether they thought their views of learning and teaching had changed, and if so, to describe how. Students created code words which were used to match up their responses to the pre- and posttests.

Responses to the questions about whether views of learning/teaching had changed were scored using the same scheme as in Study 1. Definitions of learning and teaching were scored using two scales adapted from Lonka, Joram, and Bryson (1996): a *Constructivity Scale* and an *Active Epistemology Scale* (see Appendix). The Constructivity Scale assessed participants' conceptions of learning, and levels ranged from viewing learning as a process of absorbing information, at the lowest level, to creating new information, at the highest level. The Active Epistemology Scale assessed participants' view of the learner from adopting a passive role, at the lowest

level, to adopting an active role, at the highest level. Definitions of teaching were scored according to the view of learning and the learner that they reflected. For example, Level 1 responses on the Constructivity Scale for definitions of learning included "retaining new information; consuming information; learning is gaining knowledge not previously known." Level 1 responses on the Constructivity Scale for definitions of teaching included "teaching is providing information; providing new information for students; the person who gives knowledge of subjects or important things that others haven't yet learned."

Interrater agreement was calculated for the two scales on the basis of two raters' scores on one-third of students' responses. On the Constructivity Scale, the raters agreed in 91% of the cases, and on the Active Epistemology Scale, in 92% of the cases.

Replicating the results of Study 1, only 8% of preservice teachers in Study 2 felt their views of learning and teaching did not change as a result of taking the course. Forty percent of preservice teachers reported that their views of learning had changed in that they had added new information to their existing repertoire; 30% felt this way about their views of teaching. Forty-nine percent of preservice teachers felt that a significant change had occurred in their views of learning, and 57% in views of teaching.

The results of our analysis of definitions of learning and teaching on the pre- and posttests supports preservice teachers' subjective sense that changes in

viewpoints occurred (see Tables 1 and 2). When scored on the Constructivity Scale, many more preservice teachers at posttest (42%) mentioned the idea of transfer (Level 3) as being an important part of learning than on the pretest (23%). Few preservice teachers on either pre- or posttest discussed learning in terms of restructuring knowledge or creating new knowledge (Levels 4 and 5).

When scored on the Active Epistemology Scale, preservice teachers' definitions of learning indicated that, whereas only 12% at pretest gave responses suggesting they view the learner as an active participant in the learning process (Levels 3 and 4), 36% at posttest did so. While this represents progress for some of the preservice teachers, a majority of students continued to respond at posttest with definitions suggesting a passive role for the learner (Levels 1 and 2).

Few changes in preservice teachers' definitions of teaching from pre- to posttest were detected by the Constructivity Scale, with about half of students giving the lowest level response (teaching involves presenting information so students can absorb it) at both testing times. Similarly, 15% at pretest and 19% at posttest mentioned transfer as being significant in learning, and only 2% of students at both pre- and posttest discussed teaching as facilitating the restructuring of knowledge.

The Active Epistemology Scale revealed greater change in viewpoints of teaching from pre- to posttest than did the Constructivity Scale. Whereas about the same proportion of preservice teachers at pre- and posttest gave definitions of teaching suggesting a passive role for the learner (Level 1), there was some

movement, at posttest, away from the implicitly passive responses (Level 2), to responses suggesting a more active role for the learner (Levels 3 and 4). Taken together, 22% of preservice teachers gave a Level 3 or 4 response at posttest whereas only 4% did so at pretest.

The results of Study 2 are encouraging in that they suggest, in part, preservice teachers' subjectively felt perceptions of changes in viewpoints were accompanied by actual changes in those viewpoints. Higher scores were noted in definitions of learning on the Constructivity Scale, with more frequently expressed notions of transfer responsible for most of the increase. Scores on the Active Epistemology Scale indicated that about a quarter of the preservice students expressed more active views of learning on the posttest than on the pretest. Similarly, about a fifth of the preservice teachers expressed more active views of teaching on the posttest than on the pretest. These results suggest that targeting preservice teachers' preconceptions in instruction has some impact on their perspectives. The small shifts in perspectives witnessed in this study will hopefully be augmented through other professional core courses, and eventuate in further, more extensive perspective changes for a greater number of students. What remains to be investigated in future studies is the extent to which prospective teachers' subjectively perceived, and actual changes in perspectives impact upon practice.

Why Are Preservice Teachers' Preconceptions So Difficult To Change?

Intuitive beliefs can be thought of as being more or less difficult to change depending on the type of feedback people get about those beliefs from the environment. In some cases, feedback may be outright misleading, for example, our perceptions of physical phenomenon around us are oftentimes at odds with formal physics laws. Consequently, incorrect intuitive beliefs about physics are constantly reinforced through everyday experience; this makes formal instruction which seeks to change these beliefs particularly difficult.

Feedback may also be absent in some domains or for some topics within a given domain. For example, probabilistic rules underlying many risky behaviors are difficult to appreciate because it would take many cases for the rule to be illustrated: we can drive in a car without a seatbelt and typically receive no immediate feedback that this is a risky practice. Hundreds of people would have to make hundreds of car trips without wearing seatbelts to uphold the probabilistic finding that not wearing a seatbelt increases the risk of injury when driving in a car. We believe that preservice teachers' beliefs about learning and teaching share these two disadvantageous features: they are frequently reinforced through everyday experience, and convincing corrective feedback is particularly hard to come by in the context of learning and teaching.

Reinforcing Preconceptions

Students think the most effective teachers are those who are warm and personable and who motivate their students (Holt-Reynolds, 1992) without consideration of how that teacher promotes learning in students. In fact, Holt-Reynolds (1992) points out that the preservice teachers she studied viewed "interest" as synonymous with learning: a teacher who promotes learning in her students is one who consistently makes lessons interesting regardless of other aspects of her teaching. This results in the puzzling finding that preservice teachers' criteria for the quality of a lesson may be based almost entirely on students' motivation and classroom management during that lesson. However, a lesson can appear to be going well (students are paying attention, they are quiet, and complete their assigned work), yet they may be learning very little. We know from assessments of students' knowledge in areas such as science and mathematics that this **must** be the case because by the time students reach high school they still harbor many misconceptions about subject matter (see Bruer, 1993).

While observing a teacher using cooperative learning or student-led discussion, in which perhaps a great deal of meaningful learning is going on, the student-teacher may see only that the teacher has relinquished control – students are talking with one another, not sitting in rows, and offering suggestions to the teacher rather than waiting for the teacher to "give them" knowledge. Although corrective feedback is

potentially available in this situation, the filters that student teachers observe through result, instead, in the reinforcement of their preconceptions.

Thus, there are several sources of feedback that may be at odds with each other: feedback from the management/motivation dimension and feedback from the knowledge/learning dimension. In seeking feedback about their own and others' effectiveness as teachers, preservice teachers may attend to only the management/motivation dimension. Their students seem to be learning, and this "false feedback" may serve to strengthen the preservice teacher's belief that there is no need for change in their teaching methods. Preconceptions about learning and teaching are thus reinforced through preservice teachers' observations of other teachers and through their own experiences teaching – information that would serve to disconfirm beliefs (e.g., students are typically not disabused of misconceptions when a teacher lectures) is not sought out nor attended to when present.

Another way that preservice teachers' preconceptions are reinforced through everyday experience is by observing media presentations of teaching. Popular movies, from *To Sir with Love* in the early 70s, until the recent *Dangerous Minds*, portray the task of teaching as one in which the teachers' primary challenge is to motivate and manage students. Once the teacher identifies and presses the *magic motivation button* students miraculously learn. The overweighting of the affective dimension in learning and instruction may be learned and given credence through film portrayals.

Lack of Corrective Feedback

Closely aligned with the problem of false feedback discussed above, is the absence of feedback that would serve to alter preconceptions. Preservice teachers, because of their overall conception of teaching/learning as a process of knowledge transmission, will likely aim their assessments of their students' learning at the level of facts and basic skills. Because of this, they may fail to realize that their students are learning at Bloom's knowledge level (e.g., facts, information) rather than at higher levels (e.g., understanding and interpreting arguments, critical or creative thinking).

Thus, a circular problem is created: preservice teachers may assess the success of a lesson on the basis of criteria consistent with their overall framework of learning/teaching. This is typically one in which knowledge is transmitted directly from teacher to students in a well-managed classroom, and where students' motivation is the gold-standard for learning. For those of us teaching preservice teachers, the instructional problem is how to break into the cycle of beliefs, assessment, feedback. Whereas in science teaching (e.g., Hunt & Minstrell, 1994) or statistics (Shaunessy, 1992) students' beliefs can be elicited and immediately challenged with an experiment or demonstration that illustrates their limitations, in educational psychology, demonstrations of this type are not easily performed. When showing a video-tape of an episode of teaching, whether effective or ineffective (and it is difficult to come by the latter), one cannot show that students are learning or not

learning because of any particular aspect of the teachers' behavior. Reasons for this include: our inability as teacher educators to point to features of teaching as causally related to specific types of learning; the complexity of teaching, in that a teacher will orchestrate multiple dimensions in a single episode of effective teaching (Doyle, 1986); and the lack of visible evidence that in the immediate, students are learning. For the reasons described above, therefore, preservice teachers' prior beliefs are especially intractable, and present a challenge for teacher educators.

The studies reported here suggest that targeting prior conceptions in instruction results in preservice teachers' sense that their beliefs have changed, and to a certain degree, to actual changes in the beliefs. That preservice teachers believe their perspectives have changed (apart from whether they have changed) is not without significance; other researchers (Yamamoto et al., 1969) have found that, after completing professional courses about teaching, preservice teachers evaluated their contribution as minimal with respect to their professional development. Having a subjective sense that a professional core course has made an impact on their own beliefs may make preservice teachers more receptive to other foundations and professional courses in their program. Thus, the belief changes in we found in our studies may provide an entry point which can be built upon and extended in other courses and field experiences.

The steps described above can be implemented in conjunction with other programs aimed at affecting change in prospective teachers' views, such as focusing

on instructional planning (Blumenfeld, Hicks, & Krajcik, 1996) or assessment (Taylor & Nolen, 1996). In courses taught in the future, we plan to add to the list of preservice teachers' beliefs and develop a more extensive repertoire of effective analogies, exercises, and demonstrations to work productively with these beliefs. In this way, we, as teacher educators, can develop our own pedagogical content knowledge and better effect the kinds of deep changes and transfer to practice that teacher education programs seek.

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Appendix - Constructivity and Active Epistemology Scales

Constructivity

1. Absorbing information: Learning seen as absorbing, acquiring knowledge *(e.g., learning is "consuming information"; teaching is "providing information").*
2. Understanding: Learning is viewed as understanding or comprehending new information *(e.g., learning is "gaining an understanding of previously unknown ideas"; teaching is "using the knowledge one already has and sharing it with others so they may understand the concept at hand").*
3. Transfer: Learning is seen as absorbing or understanding information, and then applying it to a situation or to solve a problem *(e.g., learning is "clearly understanding the base of a concept and being able to apply it"; teaching is "being able to present information in such a way that will allow students to apply said information in new situations").*
4. Change or reorganization takes place: Learning involves a restructuring of thinking, changing or reorganizing knowledge *(e.g., learning is "acquiring new information and concepts, applying that knowledge to other situations to change one's thinking and behavior"; teaching is "sharing knowledge that will expand others' minds").*
5. Construction of new knowledge: Learning seen as changing/restructuring plus constructing new knowledge or ideas *(e.g., learning is "taking information, combining that information with old information and personal experiences, then coming up with new ideas; teaching is "showing students or letting them show each other new ways of thinking, connecting things unknown to the student to things they already know and letting them develop ideas about the unknown things through their current knowledge").*

Active Epistemology

1. Learner viewed as object of education: Learning is the absorption of information; the learner is the passive recipient of information; To learn is to be taught. *(e.g., learning is "soaking in information that was being taught"; teaching is "effectively 'giving' knowledge and skills to students").*
2. Learner seen as implicitly passive: Learning is understanding or comprehending *(e.g., learning is "understanding and comprehending reading, lectures, or material that is presented to you"; teaching is "preparing someone to use what they learn").*
3. Learner seen as implicitly active: An active verb is used to describe learning, e.g., "learning is using mental abilities"; Learning viewed as problem solving or a process of discovery *(e.g., learning is "to discover something new that you did not know previously"; teaching is "scaffolding a person so they are able to understand or comprehend new material and connect it to past knowledge and experiences for future use or reference").*
4. Learner emphasizes being active: Learning explicitly described as an active process *(e.g., learning is "gaining new knowledge through exploration and experimentation"; teaching is "giving students the opportunity to explore and gain knowledge").*

Table 1

Frequencies of Participants' Responses on the Constructivity Scale to Definition Questions in Study 2[*]

Scale Level	Time of Test	
	Pretest	Posttest
Definitions of Learning		
1. Absorbing information	19 (36%)	15 (28%)
2. Understanding	16 (30%)	12 (23%)
3. Transfer	12 (23%)	22 (42%)
4. Change or reorganization takes place	0 (0%)	2 (4%)
5. Construction of new knowledge	1 (2%)	0 (0%)
6. Other	5 (9%)	1 (2%)
Definitions of Teaching		
1. Absorbing information	29 (55%)	27 (51%)
2. Understanding	12 (23%)	14 (26%)
3. Transfer	8 (15%)	10 (19%)
4. Change or reorganization takes place	1 (2%)	1 (2%)
5. Construction of new knowledge	0 (0%)	0 (0%)
6. Other	4 (8%)	1 (2%)

[*] n=53 on pre- and posttests

Table 2

Frequencies of Participants' Responses on the Active Epistemology Scale to Definition Questions in Study 2[*]

Scale Level	Time of Test: Pretest	Time of Test: Posttest
Definitions of Learning		
1. Learner viewed as object of education	14 (26%)	9 (17%)
2. Learner seen as implicitly passive	28 (53%)	23 (43%)
3. Learner seen as implicitly active	3 (6%)	15 (28%)
4. Emphasizes learner being active.	3 (6%)	4 (8%)
5. Other	5 (9%)	1 (4%)
Definitions of Teaching		
1. Learner viewed as object of education	29 (55%)	27 (51%)
2. Learner seen as implicitly passive	22 (42%)	15 (28%)
3. Learner seen as implicitly active	1 (2%)	7 (13%)
4. Emphasizes learner being active.	1 (2%)	4 (8%)
5. Other	0 (0%)	0 (0%)

[*] n=53 on pre- and posttests